TIMS-45 LID OPTION
(MODEL TIMS-45)
OPERATING MANUAL

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TIMS-45 LID OPTION (MODEL TIMS-45) OPERATING MANUAL

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SECTION 1 GENERAL INFORMATION

1.1 MANUAL SUMMARY

This manual contains information on Telecommunications Techniques Corporation's (TTC) TIMS-45 Lid Option (Model TIMS-45), hereinafter referred to as the TIMS-45 Option, for the FIREBERD 6000A and FIREBERD 4000 Communications Analyzers. The manual is divided into sections on: general information; option description, installation and operation, option specifications, and maintenance and service information. In addition, an appendix on factory default settings is provided.

1.2 TIMS-45 LID OPTION OVERVIEW

The TIMS-45 Option is a Transmission Impairment Measurement Set (TIMS) that provides analog testing capabilities for the FIREBERD 6000A and FIREBERD 4000 Communications Analyzers. Analog tests performed include:

- Voice Frequency (VF) testing on 2-wire and 4-wire circuits
- Wideband analog measurements for 2-wire circuits

The user interface provides a 40-character x 4-line LCD to display the current operating parameters or the measurement results for the test being performed. In addition to the display, a 16-key keypad provides the means for changing displayed configuration parameters. The keypad is also used to enter numbers for calls to be placed. A volume control enables the audio volume to be adjusted.

1.3 CABLES

The following cables are available for use with the TIMS-45 Option:

- Model 10559 — 10' cable with WECO 310 plug to bantam plug.
- Model 10599 — 4' cable with WECO 310 plug to bantam plug.
- Model 10558 — 10' cable with WECO 310 plug to alligator clips.
- Model 10420 — 10' cable with WECO 310 plug to WECO 310 plug.
- Model 10615 — 10' cable with bantam plug to bantam plug.
- Model 31063 — 10' cable with bantam plug to alligator clips.
- Model 51130 — WECO 310 plug to bantam converter plug.

SECTION 2 OPTION DESCRIPTION

2.1 INTRODUCTION

The TIMS-45 Option is menu-controlled through the option front panel. This section describes the TIMS-45 Option physical characteristics and functional characteristics.

2.2 PHYSICAL DESCRIPTION

The TIMS-45 Option replaces the FIREBERD 6000 front cover. The TIMS-45 Option has six connectors on the front panel (Figure 2-1):

- POWER
- PRINTER
- 2W/4W TX
- 4W RX
- TEL SET (2 connectors, T = Tip and R = Ring)

Each connector is described in the following paragraphs.

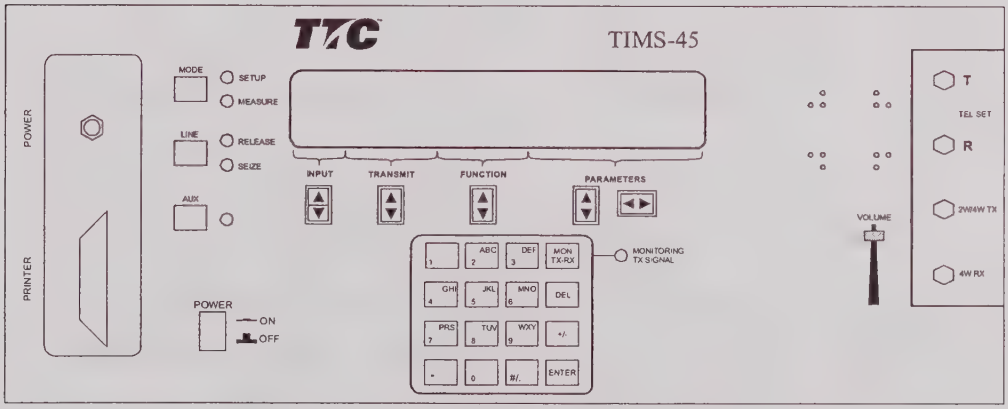

Figure 2-1. TIMS-45 Option Front Panel

2.2.1 Power Connector

The POWER connector polarity is shown in Figure 2-2. The center pin is +12 VDC and the outer ring is ground. Power can be provided to the TIMS-45 Option from the FIREBERD 6000A or FIREBERD 4000 front panel with the special cable provided.

Figure 2-2. Power Connector Polarity

2.2.2 Printer Connector

The PRINTER connector is a 25-pin, female, D-type connector which enables an external printer to be attached to the TIMS-45 Option to generate printouts of information visible on the display. Table 2-1 lists the PRINTER connector pin assignments.

Table 2-1. RS-232 Printer Connector Pin Assignments

Pin No.	Designation EIA/CCITT	Signal Designation	Status
1	AA 101	Protective Ground	Connected to chassis ground.
2	BA 103	Transmit Data (TD)	Data transmitted to the TIMS-45 Option.
3	BB 104	Receive Data (RD)	Data received from the TIMS-45 Option (to the printer).
5	CB 106	Clear to Send (CTS)	Output HIGH when the TIMS-45 Option is ready to receive.
6	CC 107	Data Set Ready (DSR)	Output HIGH when the TIMS-45 Option power is on.
7	AB 102	Signal Ground	Connected to TIMS-45 Option ground.
8	CF 109	Receive Line Signal Detector (RLSD)	Output HIGH when the TIMS-45 Option power is on.
20	CD 108/2	Data Terminal Ready (DTR)	Input must be HIGH before the TIMS-45 Option can send data.

2.2.3 2W/4W TX Connector

This connector consists of a transmit line (Tx) and a receive line (Rx). When the PORT selection is 2WIRE, the transmit and receive pairs are attached directly to the 2W/4W TX connector. When the PORT selection is 2W/2.16, the transmit and receive pairs are attached to the 2W/4W TX connector in series with a 2.16 µF capacitance termination. When the PORT selection is 4WIRE, the transmit pair is only connected to the 2W/4W TX connector.

2.2.4 4W RX Connector

When the PORT selection is 4WIRE, the transmit pair is attached to the 2W/4W TX connector and the receive pair is attached to the 4W RX connector. When the PORT selection is 2WIRE or 2W/2.16, the 4W RX connector is not used.

2.2.5 TEL SET Connectors

Two post type connectors which are used to attach an external butt set to the TIMS-45 Option for placing calls. The "T" connector provides the Tip connection and the "R" connector provides the Ring connection.

2.3 CONTROLS AND INDICATORS

The front panel of the TIMS-45 Option is shown in Figure 2-3 with each control (or control group) and indicator marked with a numbered callout. Table 2-2 provides a brief description of each control and indicator referenced to the numbered callouts in Figure 2-3.

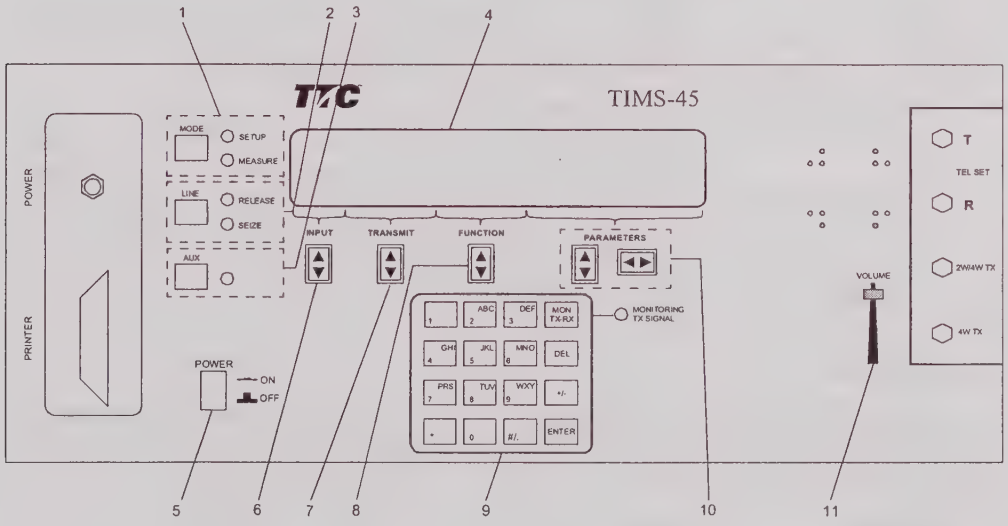

Figure 2-3. Front Panel Controls and Indicators

Table 2-2. Controls and Indicators

Callout No.	Control/Indicator	Description
1	**MODE** Key & LEDs	Used to select the operating mode of the TIMS-45 Option. This key toggles the operating mode between **Setup** and **Measure** modes. The LED next to the selected mode illuminates to indicate that it is the active operating mode.
2	**LINE** Key & LEDs	Used to alternately seize or release a two wire switched circuit. **NOTE** Seizing the line for the 2WIRE port provides a path for the loop current. When the line is released, the loop current path is opened.
3	**AUX** Key & LED	Used to select the Auxiliary operating mode of the TIMS-45 Option.
4	Display Screen	Used to display menus, messages, configuration information, and test results.
5	**POWER** Switch	Two-position pushbutton switch used to turn the TIMS-45 Option On or Off.
6	**INPUT** Switch	Up/down rocker switch, used to select the circuit termination. Pressing the UP or DOWN arrow on the switch scrolls through the selections in the corresponding direction.
7	**TRANSMIT** Switch	Up/down rocker switch, used to turn the transmitter On or Off. Pressing the UP or DOWN arrow on the switch scrolls through the selections in the corresponding direction.
8	**FUNCTION** Switch	Up/down rocker switch, used to select the test/operation to be performed. Pressing the UP or DOWN arrow on the switch scrolls through the selections in the corresponding direction.
9	Numeric Keypad	Used for data entry.
10	**PARAMETER** Switches	A pair of up/down and left/right rocker switches. The up/down rocker switch is used to select the required parameter, while the left/right rocker switch is used to select the required value. Pressing the arrow on one of the switches in the direction indicated scrolls through the selections in the corresponding direction.
11	**VOLUME** Switch	Used to control the volume of the speaker.

2.3.1 Display Screen

The display screen for the TIMS-45 Option is a four line by 40 character liquid crystal display. The arrangement of the information displayed on the screen varies depending on which operating mode is active. In **SETUP** mode the screen is arranged as follows:

INPUT field	6 characters
TRANSMIT field	7 characters
FUNCTION field	10 characters
PARAMETER field	17 characters

A typical **SETUP** display screen is shown in Figure 2-4.

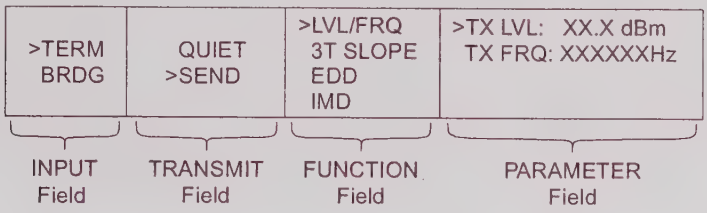

Figure 2-4. SETUP Display Screen

In **MEASURE** mode the first three lines of the display screen are used to display various parameters and the resulting measurements. The fourth line is used to display the overall SETUP selections (i.e. IMPEDANCE, PORT TYPE, FUNCTION and TLP). A typical **MEASURE** display screen is shown in Figure 2-5.

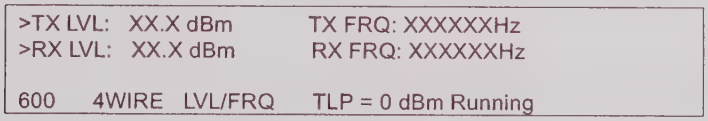

Figure 2-5. MEASURE Display Screen

SECTION 3 INSTALLATION INSTRUCTIONS

3.1 INTRODUCTION

This section describes how to install, configure, and operate the TIMS-45 Option when used with the FIREBERD 6000A and FIREBERD 4000. Refer to the appropriate Reference Manual and User's Guide for mainframe operating procedures.

3.2 OPTION INSTALLATION

The following procedure describes the steps required to remove the existing FIREBERD 6000A mainframe front cover and install the TIMS-45 Option.

1. **Turn the FIREBERD 6000A AC power off.**

   Set the FIREBERD 6000A AC power switch to the OFF position and disconnect the AC power Cord.

2. **Remove the FIREBERD 6000A front cover.**

   Open the FIREBERD 6000A front cover by pressing on the release buttons. Remove the front cover by squeezing the plastic retaining clips together and sliding the hinges apart. Release the retaining clip so that it remains in the hinges of the front cover.

3. **Attach the TIMS-45 Option to the FIREBERD 6000A.**

   Squeeze the plastic retaining clips together on the TIMS-45 Option and align the hinges with the hinges on the FIREBERD 6000A. Release the retaining clips to engage the FIREBERD 6000A hinges.

4. **Connect the POWER cable.**

   Connect the power cable from the TIMS-45 Option POWER connector to the FIREBERD 6000A 9-pin DIN connector (located below the ERROR INSERT and SELF LOOP switches).

5. **Apply power to the FIREBERD 6000A.**

   Press the FIREBERD6000A mainframe POWER switch to its ON position.

6. **Apply power to the TIMS-45 Option.**

   Press the TIMS-45 Option **POWER** switch to its ON position. When power is turned on, the TIMS-45 Option performs an internal RAM test and boots the TIMS-45 Option program. During the TIMS-45 Option boot process, the saved calibration factors and configuration data are checked for integrity. Defaults are used if the integrity checks fail. Once the TIMS-45 Option program boots, the front panel switches are used configure the TIMS-45 Option to perform the desired test(s).

SECTION 4 OPERATING INSTRUCTIONS

4.1 INTRODUCTION

This section provides a summary of the general setup and use of the TIMS-45 Option, followed by detailed descriptions of the menu selections available for the option. The TIMS-45 Option is setup and controlled by use of the option front panel switches.

4.2 BASIC SETUP PROCEDURE

This procedure provides the basic steps used to setup the TIMS-45 Option.

1. Power On the FIREBERD 6000A (or FIREBERD 4000) and then the TIMS-45 Option.
2. Press the **INPUT** switch to select either **BRDG** (Bridge) or **TERM** (Terminate).
3. Press the **TRANSMIT** switch to select either **QUIET** or **SEND**.
4. Press the **FUNCTION** switch to select the test/operation to be performed.
5. Press the **PARAMETERS** switches to set parameter values for the test/operation to be performed.
6. Connect the TIMS-45 Option to the circuit to be tested.
7. Press the **MODE** switch again to begin testing and display the accumulated results.

The front panel switches and associated menus are described in the following paragraphs.

4.3 LINE KEY

Used to either seize or release the line for a two wire switched circuit. Pressing this key toggles the selection between **SEIZE** (Off Hook) or **RELEASE** (On Hook), illuminating the LED next to the current selection.

4.4 MODE KEY

This key is used to select the TIMS-45 Option operating mode. The modes are **SETUP** and **MEASURE**. An LED next to each mode illuminates when that mode is active.

4.5 SETUP OPERATING MODE

Press the **MODE** key to select **SETUP** as the active operating mode (the LED next to the label illuminates). The **INPUT, TRANSMIT, FUNCTION**, and **PARAMETER** switches are used to configure the parameters for the test to be performed, These switches are described in the following paragraphs. A typical **SETUP** Display screen is shown in Figure 4-1.

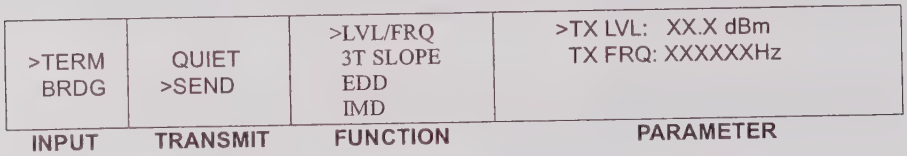

Figure 4-1. SETUP Display Screen

4.5.1 INPUT Switch

This rocker switch is used to select the termination mode for the circuit to be tested. Pressing the switch in the indicated direction scrolls through the available choices in that direction. The choices are described in the following paragraphs.

4.5.1.1 TERM

Selects Terminate mode. The option terminates the circuit with the impedance selected using the **LINE** function.

4.5.1.2 BRDG

Selects Bridge mode. This mode enables monitoring of a circuit that has already been terminated by an external device (such as a modem). The option provides a high impedance at the referenced impedance of the external device.

4.5.2 TRANSMIT Switch

This rocker switch is used to turn the transmitter either On or Off. Pressing the switch in the indicated direction scrolls through the available choices in that direction. The choices are described in the following paragraphs.

4.5.2.1 QUIET

When selected, the transmitter is turned Off and the option terminates the line with the selected impedance.

4.5.2.2 SEND

When selected, the transmitter is turned On, the option terminates the line with the selected impedance and transmits a signal at the selected level and frequency.

4.5.3 FUNCTION Switch

Used to select the type of test/operation to be performed by the TIMS-45 Option. Pressing the switch in the indicated direction scrolls through the available choices in that direction. Once a test/operation has been selected, the available parameter choices for that selection are displayed in the **PARAMETER** field. The up/down **PARAMETER** Switch is used to scroll through the available parameters and the left/right **PARAMETER** Switch (and where applicable the keypad) is used to select the value for the particular parameter. The **FUNCTION** Switch choices are described in the following paragraphs.

4.5.3.1 LINE Function

Selects the desired circuit impedance and port type for the circuit to be tested. The parameter choices for this selection are :

IMPEDANCE — Used to set the impedance for the circuit under test (default value is **600**). The choices are: **135**, **600**, **900**, or **1200**.

PORT — Used to set the type of port required for the circuit under test (default value is **4WIRE**). The choices are:

2WIRE — Selects a two (2) wire port.

2W/2.1uF — Selects a two (2) wire port with a 2.16 µF capacitance in series.

4WIRE — Selects a four (4) wire port.

The valid impedance and port combinations are shown in Table 4-1.

Table 4-1. Impedance/Port Combinations

IMPEDANCE	PORT
135	2WIRE
600	2WIRE, 4WIRE, 2W/2.16 µF
900	2WIRE, 4WIRE, 2W/2.16 µF
1200	2WIRE, 4WIRE, 2W/2.16 µF

TYPE — Used to select the type of service for the circuit under test (default value is **LEASED**). The choices are: **SWITCHED** or **LEASED**.

4.5.3.2 LVL/FRQ Function

Selects single level and frequency measurement.

NOTE

If no signal is present on the circuit being tested (i.e. the signal level is less than -50 dB) the message "**NO SIGNAL**" is displayed on the **MEASURE** mode screen.

The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB,

while the right **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dB to +10 dB.

TX FRQ — Used to set the required transmit frequency (default value is **1004 Hz**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the frequency by the STEP values listed in Table 4-3, pressing the right **PARAMETER** switch increases the frequency by the STEP values listed in Table 4-3. The range of acceptable frequencies is listed in Table 4-2.

Table 4-2. Frequency Range

IMPEDANCE	PORT TYPE	FREQUENCY RANGE
135	2WIRE	1kHz to 300 kHz
600	both 2WIRE and 4WIRE	50 Hz to 5 kHz
900	both 2WIRE and 4WIRE	50 Hz to 5 kHz
1200	both 2WIRE and 4WIRE	50 Hz to 5 kHz

Table 4-3. Frequency Step Sizes

STEP SIZE	FREQUENCY RANGE
1 Hz	50 Hz to 5 kHz
5 Hz	5 kHz to 10 kHz
10 Hz	10 kHz to 100 kHz
1 kHz	100 kHz to 300 kHz

4.5.3.3 3T SLOPE Function

Selects 3 Tone Slope as the test mode, which transmits a 404 Hz, 1004 Hz, and a 2804 Hz tone. The received signal level, frequency, and gain/loss of the signal referenced to the level of the 1004 Hz tone are measured.

NOTE

If no signal is present on the circuit being tested (i.e. the signal level is less than -50 dB) the message "**NO SIGNAL**" is displayed on the **MEASURE** mode screen.

The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dB to +10 dB.

TONE DUR — Used to set the duration of each of the three tones. The range of available settings is 5 to 60 seconds.

4.5.3.4 FREQ SWP Function

Selects a range of frequencies on which measurements are to be made.

NOTE

If no signal is present on the circuit being tested (i.e. the signal level is less than -50 dB) the message "**NO SIGNAL**" is displayed on the **MEASURE** mode screen.

The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dB to +10 dB.

FR FRQ — Used to set the starting frequency on which measurements are to be made. The keypad is used to enter the desired value. The range of valid frequencies is listed in Table 4-4.

Table 4-4. Frequency Sweep — Valid Frequency Ranges

Valid Impedance	Port Type	Valid Ranges	Default Values
600, 900, 1200	ALL	FR FRQ — 50 Hz to TO FRQ (or 50 kHz) TO FRQ — FR FRQ (or 50 Hz) to 5 kHz	FR FRQ — 200 Hz TO FRQ — 4 kHz STEPSIZE — 100 Hz
135	2WIRE	FR FRQ — 1 kHz to TO FRQ (or 300 kHz) TO FRQ — FR FRQ (or 1 kHz) to 300 kHz	FR FRQ — 1 kHz TO FRQ — 65 kHz STEPSIZE — 1 kHz

TO FRQ — Used to set the ending frequency on which measurements are to be made. The keypad is used to enter the desired value. The range of valid frequencies is listed in Table 4-4.

STEP — Used to set the step size for the frequency sweep. The parameter choices for this selection are: **1**, **5**, **10**, **100**, **1000**, and **10000** Hz.

SWP DUR — Used to set the length of time that the TIMS-45 Option dwells at each frequency in the sweep (default value is **5** seconds). The time range is three (3) seconds to ten (10) seconds. The keypad is used to enter the desired value.

SKP FR — Used to set the minimum value for an intermediate range of frequencies that are to be skipped during the frequency sweep (default value is **2600**). The keypad is used to enter the desired value. The valid range of frequencies is from the **FR FRQ** to the **SKP TO** or **TO FRQ** (which ever is lower).

SKP TO — Used to set the maximum value for an intermediate range of frequencies that are to be skipped during the frequency sweep (default value is **2800**). The keypad is used to enter the desired value. The valid range of frequencies is from the **SKP FR** or **FR FRQ** (which ever is higher) to the **TO FRQ**.

4.5.3.5 VFLPBK Function

Used to select either internal loopback or to transmit a loopback signal (2713 Hz). The parameter choices for this selection are:

TOGGLE RMT — Transmits the 2713 Hz loopback signal to either loop up or loop down the far end device.

SET LOCAL — Places the local TIMS-45 Option in a loopback condition, the line receiver is connected to the line transmitter.

CLR LOCAL — Removes the local loopback condition, the receiver and transmitter are no longer connected together.

NOTE

The **MODE** key must be pressed to activate the Loopback. "`Loopback Enabled`" will appear on the screen when the loopback has been activated.

4.5.3.6 DIAL Function

Used for switched line types, to select the digit type to be transmitted on the circuit under test and to enter the required digits. The parameter choice for this selection is:

DIAL MODE — Selects the digit type to be transmitted. The choices are:

DP — Selects Dial Pulse as the digit type (2 wire circiuts only).

DTMF — Selects Dual Tone Multifrequency as the digit type.

NOTE

The "*" and "#" keys are not valid entries for **DP** dialing.

Once the digit type has been selected, the user can enter a number (up to 16 digits) using the keypad. The numbers are displayed in the **PARAMETER** field as they are entered. The **ENTER** key (located on the keypad) must be pressed to set the desired number. The **MODE** key is then pressed to the **SEIZE** position (the LED next to **SEIZE** illuminates) to outpulse the digits. The following message is displayed in the **PARAMETER** field: "`DIALING DIGITS`", after the call has been setup the message "`Call Established`" is displayed in the **PARAMETER** field.

4.5.3.7 ID NOISE Function

Selects Idle Channel Noise as the test to be performed. In this test no signal is transmitted. Instead, the inherent noise on the line is measured. The parameter choice for this selection is:

FILTER — Selects the filter used to make the Idle Channel Noise measurements (default value is **C-MSG**). The choices are :**C-MSG**, **D-FILTER**, **PROGRAM**, **3.4K-FLAT**, **3K FLAT**, **15K FLAT**, **50Kbit**, **E-FILTER**, and **F-FILTER**.

4.5.3.8 1K NOISE Function

Selects a noise with tone test, where the Option transmits a 1010 Hz holding tone on the line. The received 1010 Hz tone is notched out using a 1010Hz Notch filter and the resulting noise is measured through one of the selected filters. In addition, the Option measures the signal-to-noise ratio.

NOTE

If no holding tone is detected, the message "`No Signal`" is displayed on the **MEASURE** mode screen.

The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dB to +10 dB.

FILTER — Used to select the required filter to be applied for the **1K NOISE** test (default filter is **C-NTCH**). The choices are: **C-NTCH**, **3K-NTCH**, **PROGRAM**, **3.4K-NTCH**, **15K FLAT**, and **D-NTCH**.

4.5.3.9 GD NOISE Function

Selects the Noise-to-Ground test, in which the noise on the line is measured referenced to ground. The parameter choice for this selection is:

FILTER — Used to select the filter to be applied during the Noise-to-Ground test (default filter is **C-MSG**). The filter choices are: **C-MSG**, **D-FILTER**, **PROGRAM**, **3.4K-FLAT**, **3K-FLAT**, **15K FLAT**, **50Kbit**, **E-FILTER**, and **F-FILTER**.

4.5.3.10 RET LOSS Function

Selects the Echo Return Loss (ERL) test. In this test the Option transmits the ERL, Singing Hi and Singing Lo signals while performing the respective measurements. The parameter choices for this selection are :

TX LVL — Used to set the required transmit level (default value is **-10 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to -2 dBm.

4.5.3.11 EDD Function

Selects the Envelope Delay Distortion test (only available when **PORT** is set to **4WIRE**), in which the Options transmits the EDD signal (an 1800 Hz reference tone) and then performs the associated measurement. The parameter choices for this selection are:

CONFIG — Used to set the EDD configuration to either **DIRECTOR** or **RESPONDER**.

When **DIRECTOR** is the selected **CONFIG** type (and **MODE** is set to **RET-REF**), the **Enter** key must be pressed to display the following additional parameters under **TX LVL**:

FR FRQ — Used to set the starting frequency on which measurements are to be made (default value is **300 Hz**). The keypad is used to enter the desired value. The valid entry range is 200 Hz to the **TO FRQ** (or 4000 Hz).

TO FRQ — Used to set the ending frequency on which measurements are to be made (default value is **3500 Hz**). The keypad is used to enter the desired value. The valid entry range is from the **FR FRQ** (or 200 Hz) to 4000 Hz.

NOTE

The TIMS-45 Option automatically skips the frequency range of 2600 Hz to 2800 Hz.

STEP — Used to set the step size (default value is **100 Hz**). The valid entry range is 10 Hz to 100 Hz.

SWP DUR — Used to set the length of time for the frequency sweep (default value is **5** seconds). The time range is five (5) seconds to ten (10) seconds. The keypad is used to enter the desired value.

NOTE

These parameters are also available when the **CONFIG** type is set to **RESPONDER** and the **MODE** is set to **FWD REF**. When **RESPONDER** is the selected **CONFIG** type and the **MODE** is set to **RET REF**, there are no additional parameters added under **TX LVL**.

MODE — Used to set the operating mode for the EDD test. The **Enter** key must be pressed to display the following additional parameters:

RET-REF — Selects Return Reference mode as the operating mode. In this operating mode the following sequence of events takes place:

1. The **DIRECTOR** (MASTER) transmits an 1800 Hz reference tone (modulated at 83 1/3 Hz) which the **RESPONDER** (SLAVE) receives and retransmits.
2. The **DIRECTOR** automatically uses the 1800 Hz tone as the zero reference delay for all subsequent measurements.

NOTE

When the **DIRECTOR** first receives the 1800 Hz reference tone, the actual delay is displayed for three (3) seconds before automatically "zeroing the delay" to zero. The user can see the actual delay at 1800 Hz later by going to the **RESULT** mode after the test has been completed

3. The **DIRECTOR** then transmits variable frequencies from 300 Hz to 3.5 kHz to the **RESPONDER**.
4. The **RESPONDER** records the modulation and retransmits this modulation over the 1800 Hz carrier tone to the **DIRECTOR**.
5. The **DIRECTOR** measures and displays the delay, referenced to the zero reference delay at 1800 Hz, along with the RX level at each frequency.

FWD-REF — Selects Forward Reference mode as the operating mode. In this operating mode the following sequence of events takes place:

1. The **RESPONDER** receives an 1800 Hz reference tone (with 83 1/3 Hz modulation) from the **DIRECTOR**.
2. The **RESPONDER** retransmits the reference tone (with modulation) to the **DIRECTOR**.

3. The **DIRECTOR** uses the delay at this carrier as a zero reference delay automatically.
4. The **RESPONDER** sweeps the selected frequency range with an 83 1/3 Hz modulation three (3) seconds after the 1800 Hz tone has been sent to the **DIRECTOR**.
5. The **DIRECTOR** records the delay at each frequency referenced to the delay at the reference frequency.

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to 0 dBm.

NOTE

The frequency range of 2600 Hz to 2800 Hz is automatically skipped by the TIMS-45 Option.

4.5.3.12 IMD Function

Selects the Intermodulation Distortion test, in which the Option transmits two IMD test tone pairs and then measures the results. The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to 0 dBm.

MODE — Used to select the operating mode for the IMD test. The choices are:

IMD — When selected as the IMD operating mode, the TIMS-45 Option sends both pairs of test tone signals (857 Hz & 863 Hz are the lower pair and 1372 Hz & 1388 Hz are the upper pair) and then performs the measurement.

S/N CHK — When selected as the IMD operating mode, the TIMS-45 Option sends only the upper pair of test tone signals (1372 Hz & 1388 Hz) and then performs a signal-to-noise measurement with the results being subtracted from the IMD results.

4.5.3.13 P/AR Function

Selects the Peak-to-Average Ratio test, in which the Option transmits a signal at the predefined level and then measures the P/AR of the received signal.

NOTE

If an input signal is not detected, the message "`NO SIGNAL`" is displayed on the **MEASURE** mode display.

The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to 0 dBm.

4.5.3.14 TRANS Function

Selects transient measurements as the test to be performed. In this test, the following measurements are performed (with a 1004 Hz holding tone provided): Impulse Noise, Phase & Jitter Hits, Gain Hits, and Dropouts. The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **0 dBm**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to +10 dBm.

FILTER — Used to select the filter to be used during the test. The choices are **C-NOTCH**, **D-NOTCH**, **E-FILTER**, or **F-FILTER**.

DUR — Used to set the duration of the test (default value is **15:00**). The choices are:

CONT — Selects a test duration of 100 minutes.

00:00 — Used to set the test duration. The keypad is used to enter the desired value. The valid range of entries is 60 seconds to 99:99 minutes.

GAIN HIT — Used to set the gain hit threshold (default value is **6dB**). The choices are: **2dB**, **4dB**, **6dB**, **8dB** or **10dB**.

PHASE HIT — Used to set the phase hit threshold (default value is **15 deg**). The valid range of entries is five (5) degrees to 45 degrees in steps of five (5) degrees. The left and right **PARAMETERS** keys are used to set the value.

IMP LO — Used to set the Impulse Noise Low threshold. Once the **IMP LO** value has been entered, the TIMS-45 Option automatically sets the IMP MID and IMP HI thresholds to +4dBrn and +8dBrn, respectively. The range of valid entries for **IMP LO** are shown in Figure 4-5

Table 4-5. Impulse Noise Low Threshold Value Range

FILTER	C	D	E	F
IMP LO	30dBrn	30dBrn	30dBrn	40dBrn
IMP HI	110dBrn	110dBrn	110dBrn	110dBrn

4.5.3.15 JITTER Function

Selects jitter measurement tests (not available when **IMPEDANCE** is set to 135 Ω). Jitter amplitude and/or phase jitter can be selected. The parameter choices for this selection are:

TX LVL — Used to set the required transmit level (default value is **-13 dB**). The keypad can be used to enter the desired value. In addition, pressing the left **PARAMETER** switch decreases the value by 0.1 dB, while the right the left **PARAMETER** switch increases the value by 0.1 dB. The range of acceptable level values is from -40 dBm to +10 dBm.

NOTE

If an input signal is not detected, the message "**NO SIGNAL**" is displayed on the **MEASURE** mode display.

4.6 MEASURE OPERATING MODE

Once the required test and associated parameters have been set, the **MODE** key is pressed to select the **MEASURE** as operating mode and begin the test. When selected as the active operating mode, the LED next to the **MEASURE** label illuminates indicating the displayed results information is for the test being performed. The top three display lines show various input parameters and the resulting measurements. The fourth line of the display shows the current settings for **IMPEDANCE**, **PORT**, **MODE**, and **TLP** (Transmission Level Point). A typical **MEASURE** Display screen is shown in Figure 4-2. Table 4-6 provides a description of the **MEASURE** Mode results. The results are grouped with their associated **FUNCTION**, in alphabetical order by **FUNCTION**.

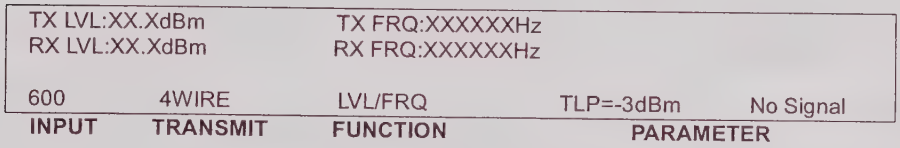

Figure 4-2. MEASURE Display Screen

Table 4-6. MEASURE Mode Results

Function	Result Name	Description
LVL/FREQ (When no input signal is received by the TIMS-45 Option (i.e. the signal level is less than -50dBm) the message "**NO SIGNAL**" is displayed on line four of the **MEASURE** screen.)	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
	TX FRQ	Displays the transmit frequency in Hz.
	TX LVL	Displays the transmit signal level in dBm.

Table 4-6. MEASURE Mode Results (Continued)

Function	Result Name	Description
3T SLOPE (When no input signal is received by the TIMS-45 Option (i.e. the signal level is less than -50dBm) the message "`NO SIGNAL`" is displayed on line four of the **MEASURE** screen.)	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
	RX SLP	Displays the gain/loss of the received signal level in dB.
FREQ SWP (When no input signal is received by the TIMS-45 Option (i.e. the signal level is less than -50dBm) the message "`NO SIGNAL`" is displayed on line four of the **MEASURE** screen.)	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
	TX FRQ	Displays the transmit frequency in Hz.
	TX LVL	Displays the transmit signal level in dBm.
ID NOISE	FILTER	Displays the filter being used to make the idle channel noise measurements.
	NOISE	Displays the idle channel noise measured on the line in dBrn.
1K NOISE (When no holding tone is received by the TIMS-45 Option the message "`NO TONE`" is displayed on line four of the **MEASURE** screen.)	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
	FILTER	Displays the filter being used to make the noise with tone measurements.
	NOISE	Displays the noise measured on the line in dBrn.
	SNR	Displays the signal-to-noise value for the line under test in dB.
GD NOISE	NOISE	Displays the value of the noise referenced to ground on the line in dBrn.
	FILTER	Displays the filter being used to make the ground noise measurement
RET LOSS	RX LVL	Displays the received signal level in dBm.
	TX LVL	Displays the transmit signal level in dBm.
	ERL	Displays the level of the transmitted noise (filtered per the Echo Return Loss (ERL) specifications of IEEE Std. 743), in dB.

Table 4-6. MEASURE Mode Results (Continued)

Function	Result Name	Description
RET LOSS (continued)	SI LO	Displays the level of the transmitted noise (filtered per the Singing Return Loss Low specifications of IEEE Std. 743), in dB.
	SI HI	Displays the level of the transmitted noise (filtered per the Singing Return Loss High specifications of IEEE Std. 743), in dB.
EDD — FWD REF Mode	Delay	Displays the Envelope Delay Distortion in µSec. **NOTE** Only displayed when **DIRECTOR** is the selected **CONFIG** type).
	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
EDD — RET REF Mode (If EDD is selected when 2WIRE is the current PORT setting, the message "**AVAILABLE ONLY ON 4 WIRE CIRCUITS**" is displayed on line four of the **MEASURE** screen.)	Delay	Displays the Envelope Delay Distortion in µSec. **NOTE** Only displayed when **DIRECTOR** is the selected **CONFIG** type).
	RX FRQ	Displays the received frequency in Hz.
	RX LVL	Displays the received signal level in dBm.
	TX LVL	Displays the transmit signal level in dBm.
IMD — IMD Mode	IMD2	Displays the second order Intermodulation Distortion in dB (per IEEE Std. 743).
	IMD3	Displays the third order Intermodulation Distortion in dB (per IEEE Std. 743).
	RX LVL	Displays the received signal level in dBm.
	TX LVL	Displays the transmit signal level in dBm.
IMD — S/N CHK Mode	IMD2	Displays the second order Intermodulation Distortion in dB (per IEEE Std. 743).
	IMD3	Displays the third order Intermodulation Distortion in dB (per IEEE Std. 743).
	RX LVL	Displays the received signal level in dBm.
	S/N	Displays the signal-to-noise ratio (i.e. the SNR results are subtracted from the IMD results) in dB.
	TX LVL	Displays the transmit signal level in dBm.

Table 4-6. MEASURE Mode Results (Continued)

Function	Result Name	Description
P/AR (When no input signal is received by the TIMS-45 Option (i.e. the signal level is less than -50dBm) the message "`NO SIGNAL`" is displayed on line four of the **MEASURE** screen.)	P/AR	Displays the peak-to-average value of the received signal as a percent.
	RX LVL	Displays the received signal level in dBm.
	TX LVL	Displays the transmit signal level in dBm.
TRANS	DO	Displays the number of dropouts that occurred during the test.
	GH	Displays the number of Gain Hits that occurred during the test.
	HIGH	Displays the number of times the Impulse Noise High threshold was exceeded during the test.
	LOW	Displays the number of times the Impulse Noise Low threshold was exceeded during the test.
	MID	Displays the number of times the Impulse Noise Mid threshold was exceeded during the test.
	PH	Displays the number of Phase Hits that occurred during the test.
	RX LVL	Displays the received signal level in dBm.
	TIME	Displays the running time of the test in minutes and seconds.
	TX LVL	Displays the transmit signal level in dBm.
JITTER (If the TIMS-45 Option is configured for 135 Ω termination, the message "`NOT AVAILABLE FOR 135 OHM IMPEDANCE`" is displayed on line four of the **MEASURE** screen.)	AMPLITUDE	Displays the amplitude of the measured jitter as a percent.
	PHASE	Displays the phase of the measured jitter in degrees.
	RX LVL	Displays the received signal level in dBm.
	TX LVL	Displays the transmit signal level in dBm.
RESULT (**NOTE**: Must be in **AUX** mode)	Delay	Displays the Envelope Distortion Delay in mSec when EDD is the selected test.
	RX FRQ	Displays the received frequency in Hz when EDD or FRQ SWP is the selected test.

Table 4-6. MEASURE Mode Results (Continued)

Function	Result Name	Description
RESULT (continued)	RX LVL	Displays the received signal level in dBm when EDD or FRQ SWP is the selected test.
	TX FRQ	Displays the transmit frequency in Hz when EDD or FRQ SWP is the selected test.

4.7 RECEIVING A REMOTE LOOPBACK SIGNAL

Once a call has been established or the line is in a seized condition (2WIRE circuit) and the TIMS-45 Option is idle, a remote loopback tone may be received. When this occurs, the screen will display the message shown in Figure 4-3.

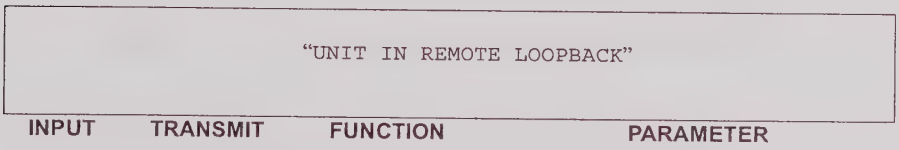

Figure 4-3. Remote Loopback Screen

NOTE

A loopback tone is the reception of a signal between 2706 Hz and 2720 Hz at a level between -24 dBm and +10 dBm. The user can disable the remote loopback by going to the **VF LPBK** function and enabling "**CLR LOCAL**".

SECTION 5 AUXILIARY MODE/PRINTER FUNCTIONS

5.1 AUX OPERATING MODE

ThE AUX key is used to select the TIMS-45 Option Auxiliary operating mode. The LED next to the AUX key illuminates to indicate that auxiliary mode is active. An example of a typical Auxiliary screen is shown in Figure 5-1.

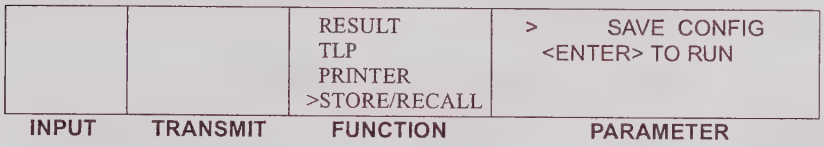

Figure 5-1. Typical AUXILIARY Display Screen

The following paragraphs describe the selections available in the Auxiliary operating mode:

5.1.1 RESULTS Function

Used to display the most recent results for either the **EDD** test or the **FRQ SWP** test.

NOTE

These results are not saved when the TIMS-45 Option is powered Off.

When **EDD** is selected and the **EDD MODE** is set to **FWD-REF** (FORWARD reference), the following results are displayed:

RX FRQ (Hz)	Delay (mSec)
1800	XXXX
1800	Ref 0
XXXX	XXXX

When **EDD** is selected and the **EDD MODE** is set to **RET-REF** (RETURN reference), the following results are displayed:

TX FRQ (Hz)	RX LVL (dBm)	Delay (mSec)
1800	XX.X	XXXX
1800	XX.X	Ref 0
XXXX	XX.X	XXXX

When **FREQ SWP** is selected the following results are displayed:

RX FRQ (Hz)	RX LVL (dBm)
XXXXXX	XX.X
XXXXXX	XX.X
XXXXXX	XX.X

5.1.2 TLP Function

Used to select the Transmission Level Point (default value is **0dBm**). The required value is entered via the keypad. The compensation (corrected value) provided by the **TLP** is defined as the Absolute Value (in dBm) - the TLP (in dBm) = Corrected Value (dBm0). Table 5-1 provides examples of the TLP compensation. The valid range of entries is +10dBm to -19dBm.

Table 5-1. Examples of TLP Compensation

Example 1	Example 2	Example 3
TLP = +13 dBm Absolute Value = 0 dBm Corrected: 0 - (13) = -13 dBm0	TLP = -17.7 dBm Absolute Value = -20 dBm Corrected: -20 - (-17.7) = -2.3 dBm0	TLP = -3 dBm Absolute Value = -6.4 dBm Corrected: -6.4 - (-3) = -3.4 dBm0

5.1.3 PRINTER Function

Used to set the parameters for the RS-232C printer port. The parameter choices for this selection are:

PARITY — Selects the required parity, either **EVEN**, **ODD**, or **NONE** (default value is **NONE**).

DATA BITS — Selects the required number of data bits, either 7 or 8 (default value is **8**).

BAUD RATE — Selects the required baud rate (default value is **2400**), the choices are **1200**, **2400**, **4800**, or **9600**

5.1.4 STORE/RECALL Function

Used to store (save) the current configuration or to recall a stored configuration or the factory default settings. The parameter choices for this selection are:

SAVE CONFIG — Stores the current TIMS-45 Option configuration.

RESTORE CONFIG — Recalls a stored configuration.

LOAD DEFAULT — Restores the factory default settings.

NOTE

The **ENTER** key is used to make the desired selection. Once the selection is made the **AUX** key is pressed a second time (AUX LED turns off) to return to either **SETUP** or **MEASURE** mode. The changes do not take place until the **ENTER** key is pressed and the user returns to either **SETUP** or **MEASURE** mode.

5.2 PRINT FUNCTIONS

The TIMS-45 Option will print any "**MEASURE**" screen to the RS-232 port, once the Printer Auxiliary Function parameters have been set. The printout is generated by pressing the **ENTER** key while in the **MEASURE** operating mode. The printout generated contains **Results** information for the displayed screen.

SECTION 6 OPTION SPECIFICATIONS

6.1 INTRODUCTION

This section contains the specifications for the TIMS Option. This information is listed in Table 6-1.

Table 6-1. TIMS Option Specifications

Item	Specification
Dimensions: Length: Width: Height:	 13.988 in. 2.080 in. 5.838 in.
Weight:	3.7 lbs. (1.68 kg).
Display Type:	40 character, 4 line LCD display.
Power Sources:	Class 2 Transformer, 12VDC, 1.5 A. 12 VDC via FIREBERD 6000A or FIREBERD 4000 Printer Port using cable supplied with the TIMS-45 Option.
Environmental Requirements: Operating Temperature: Relative Humidity: Altitude:	 0°C to 50°C. 10% to 90%, non-condensing. < 5,000 meters.
External Interfaces:	2 wire interface port. 2 wire post for Butt set. 4 wire interface port.
Line Impedances:	135Ω — 2Wire interface port only. 600Ω — 2Wire, 4Wire, and 2 Wire w/2.16 µF. 900Ω — 2Wire, 4Wire, and 2 Wire w/2.16 µF. 1200Ω — 2Wire, 4Wire, and 2 Wire w/2.16 µF. Bridge (at 135Ω, 600Ω, 900Ω, or 1200Ω reference).
Level/Frequency Mode Measurements Transmitter: Frequency Range: Output Level Range: Output Level Step Size: Output Level Accuracy (@ 1kHz): Total Distortion:	 50 Hz to 300 kHz at 0dBm. 100 Hz to 300 kHz at +10 dBm. +10 dB to -40 dB. 0.1 dB. ±0.1 dB in the range of 0 to -10 dBm. ±0.2 dB over the range of +10 to 0 and -10 to -40 dBm. >40 dB.

Table 6-1. TIMS Option Specifications (Continued)

Item	Specification
Level/Frequency Mode Measurements	
Receiver:	
Level Measurements:	
Input Level Range:	+10 dBm to -49.9 dBm (+20 Bm to -43 dBm 135 Ω only)
Accuracy	±0.2 dBm at 1 kHz (+0 dBm to -19 dBm). ±0.2 dBm from 200 Hz to 15 kHz (+10 dBm to -50 dBm). ±0.5 dBm for any frequency range above 15kHz and below 200 Hz.
Frequency Measurements:	50 Hz to 300 kHz.
Frequency Range:	+10 dBm to -50 dBm.
Level Range:	1 Hz.
Resolution:	±1 Hz between 50 Hz and 20 kHz.
Accuracy:	±5 Hx between 20 kHz and 300 kHz.
Noise Measurements	
Input:	Balanced or Noise to Ground.
Weighting Filters:	C-Message, 3.4 kHz Flat, D-Filter, 15 kHz Flat, 3 kHz Flat, and Program.
Wideband Filters:	E-Filter, F-Filter, and 50 kbit.
Notch Filter:	1010 Hz (995 Hz to 1025 Hz Notch).
Range:	10 dBrn to 90 dBrn (Balanced) 40 dBrn to 130 dBrn (Noise to Ground)
Accuracy:	±1 dB
Signal to Noise Ratio Measurements	
S/N Range:	10 dB to 45 dB.
Accuracy:	±1 dB (10 dB to 40 dB) ±2 dB (41 dB to 45 dB)
Display Response Time:	4 seconds (for a suddenly applied random noise signal with holding tone).
Three Tone Slope Measurements:	Same as for Level/Frequency Mode Measurements.
Return Loss Measurements	
Modes:	ERL, SRL HI, and SRL LO.
Signal Source:	Pseudo-random wide band noise with flat distribution (200 Hz to 4 kHz).
Output Level:	-2 dBm to -10 dBm.
Accuracy:	±0.5 dB.
Range:	0 to 50 dB (4 wire circuits). 0 to 40 dB (2 wire circuits).
Peak to Average Ratio (P/AR) Measurements.	
Output Level Range:	0 dBm to -40 dBm.
Accuracy:	±2 P/AR units (in the range of 40 units to 110 units). ±4 P/AR units (under 40 units and over 110 units).
Range:	0 to 120 P/AR units.
Resolution:	1 P/AR unit.
Input Level Range:	0 dBm to -40 dBm.

Table 6-1. TIMS Option Specifications (Continued)

Item	Specification
Intermodulation distortion. Measurements	
Transimtter:	
Signal Spectrum:	857 Hz, 863 Hz, 1372 Hz, and 1388 Hz.
Level Variation between tones:	±0.25 dB.
Output Level Range:	0 dBm to -40 dBm.
Output Level Accuracy:	±1 dB.
Output Level Step Size:	±0.5 dB
Receiver:	
Input Level Range:	0 dBm to -40 dBm.
Accuracy:	±1 dB.
Envelope Delay Distortion Measurements	
Transmitter:	
Modulating Signal Frequency:	83 1/3 Hz.
Modulation Depth:	50% ±5%.
Carrier Frequency:	300 Hz to 3900 Hz (selectable).
Carrier Frequency Accuracy:	±4 Hz.
Output Level Range:	0 dBm to -40 dBm.
Output Level Step Size:	0.1 dBm.
Flatness:	±2 dB (300 Hz to 3900 Hz).
Receiver	
Resolution:	10 µsec.
Range:	10,000 µsec (max.)
Input Signal Level:	+10 dBm to -40 dBm.
Frequency Accuracy:	±4 Hz.
Filters:(see IEEE Std. 743 for complete specifications for these filters).	3 kHz - Flat - used to qualify voice circuits. 3 kHz - Notch - used to qualify voice circuits. 3.4 kHz Flat - used to qualify voice circuits. 3.4 kHz Notch - used to qualify voice circuits. 15 kHz Flat - used to qualify program broadcast circuits. 50k Bit - used to qualify DDS circuits. C-MSG - used to qualify voice circuits. C-Notch - used to qualify voice circuits. D Filter - used to qualify circuits containing analog modems. D Notch - used to qualify circuits containing analog modems. E Filter - used to qualify ISDN circuits. ERL Filter - used for echo return loss VF testing. F Filter - used to qualify HDSL circuits. Intermodulation - used for Voice Frequency (VF) IMD testing. PAR - used for P/AR (peak to average) testing. Program Filter - used to qualify program broadcast circuits. SRL - Lo - used for echo return loss VF testing. SRL - Hi - used for echo return loss VF testing.
Signaling Types:	DP (Dial Pulse). (2 wire and 4 wire ports) DTMF (Dual Tone Multifrequency). (4 wire port only).
Ring Detection:	On 2Wire port.

SECTION 7 WARRANTY AND SERVICE

7.1 WARRANTY INFORMATION

7.1.1 Warranty Policy

All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

The TIMS-45 Option will be repaired or replaced (at our option) at no charge for a period of two (2) years after shipment to the customer.

Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions.

1. Equipment has been altered or repaired without specific authorization from TTC.

2. Equipment is installed or operated other than in accordance with instructions contained in TTC literature and operating manuals.

No other warranty is expressed or implied. TTC is not liable for any direct, indirect, incidental, or consequential damages.

7.2 SERVICE INFORMATION

7.2.1 In-Warranty Service

Equipment in warranty must be returned to the factory or authorized service center with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Section 7.3, Equipment Return Instructions. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the nearest TTC Repair Center. The RA number should appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it is tested to applicable specifications and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used is provided on the Equipment Repair Report furnished with the returned equipment.

7.2.2 Out-of-Warranty Service

The procedure for repairing out-of-warranty equipment is the same as the one used for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department for specific information on the minimum out-of-warranty repair charge.

The customer will be billed for parts plus standard labor rates in effect at the time of the repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A description of the labor and materials used is provided in the Equipment Repair Report.

Once an out-of-warranty repair is made, the repaired part or component is warranted for one (1) year. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the one (1) year repair warranty.

7.3 EQUIPMENT RETURN INSTRUCTIONS

To all equipment returned for repair, attach a tag that includes the following information.

1. Owner's name and address.
2. A list of the equipment being returned and the applicable serial number(s).
3. A detailed description of the problem or service requested.
4. The name and telephone number of the person to contact regarding questions about the repair.
5. The Return Authorization (RA) number.

If possible, return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit; when needed, appropriate packing materials can be obtained by contacting TTC's Repair Department. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA number on the outside of the package and ship it prepaid and insured to TTC.

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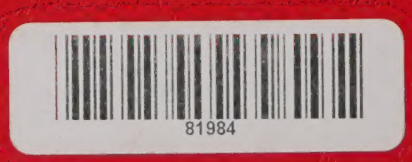
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